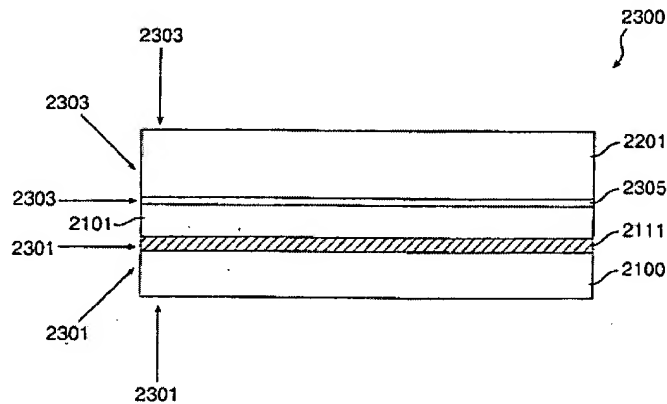


REMARKS/ARGUMENTS

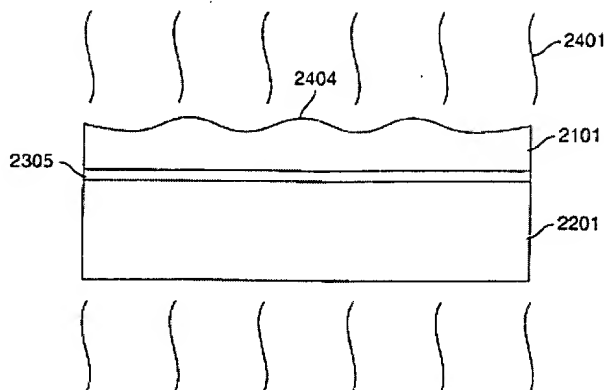
No claims are amended or canceled by the instant response. Accordingly, claims 1-23 remain pending.

Embodiments in accordance with the present invention relate to methods for reducing surface roughness of films. For example, an embodiment of the present invention shown and described in connection with Figure 14 (reproduced below), describes forming a silicon-on-insulator (SOI), wherein two wafers are bonded together and then cleaved apart in a different location:



After bonding the wafers into a sandwiched structure 2300, as shown in FIG. 14, the method includes a controlled cleaving action to remove the substrate material to provide a thin film of substrate material 2101 overlying an insulator 2305 the target silicon wafer 2201. The controlled-cleaving occurs by way of selective energy placement or positioning or targeting 2301, 2303 of energy sources onto the donor and/or target wafers. (Page 18, lines 28-33)

As illustrated in Figure 15 (reproduced below):



the detached surface of the film of silicon material 2101 is often rough and needs finishing:

[a]ccordingly, the present method subjects the cleaved film to a combination of etching and deposition using a hydrogen bearing compound and a silicon bearing compound. Additionally, the cleaved surface undergoes thermal treatment while being subjected to the combination of etchant and deposition gases. (Emphasis added; page 22, line 31 - page 23, line 2).

Thus in accordance with embodiments of the present invention, the same non-uniform surface (silicon material 2101 of Figures 14 and 15) is subjected to the following processes at the same time: (1) thermal treatment; (2) etching; and (3) deposition. Pending independent claims 1, 20, and 22 are drawn to such embodiments:

1. A method of fabricating substrates, the method comprising:
... applying a combination of a deposition species for deposition of a deposition material and an etching species for etching an etchable material during a portion of time that the non-uniform surface is subjected to the etching, the combination of the deposition species and the etching species contacting the non-uniform surface in a thermal setting to reduce a level of non-uniformity of the non-uniform surface by filling a portion of the defects to smooth the film of material, the film of material being substantially free from the defects and being characterized by a surface roughness of a predetermined value. (Emphasis added)

20. A method of fabricating substrates, the method comprising:
... applying simultaneously to the non-uniform surface in a thermal setting a combination of a silicon-containing-deposition species for deposition of a deposition material and a halogen-containing-etching species for etching an etchable material in order to smooth the surface. (Emphasis added)

22. A method of fabricating substrates, the method comprising:

. . . applying simultaneously to the non-uniform surface a combination of a silicon-containing-deposition species for deposition of a deposition material and a halogen-containing-etching species for etching an etchable material in order to smooth and reduce a level of non-uniformity of the non-uniform surface, the halogen-containing-etching species including HCl,

wherein the combination of the deposition species and the etching species are contacting the non-uniform surface placed in a thermal setting of a temperature of about 1,000 degrees Celsius or greater. (Emphasis added)

In the latest office action, the Examiner rejected the pending claims as obvious under U.S.C. § 103(a), in view of U.S. Patent No. 5,869,387 to Sato et al. ("the Sato patent"), taken alone or in combination with other references. These claim rejections are overcome as follows.

The Examiner is reminded that in order to establish a prima facie case of obviousness, "the prior art reference (or references when combined) must teach or suggest all the claim limitations." MPEP 2142. Here, while the Sato patent describes a number of embodiments for forming a SOI structure, none teaches or even suggests simultaneous exposure of the same non-uniform surface to (1) thermal; (2) etching; and (3) deposition conditions.

A first embodiment of the Sato patent describes reducing the surface roughness of a silicon material through exposure to thermal treatment in a hydrogen ambient. There is no mention of deposition during this smoothing process, and the Sato patent explicitly indicates that there is no etching:

surface roughness of monocrystalline silicon having a roughness of about several nm to several tens of nm in terms of the p-v value in a cycle of several nm to several hundreds of nm (FIG. 1A) can be flattened by heat treatment in a reducing atmosphere to a p-v value of several nm or less, or 2 nm or less under optimum conditions (FIG. 1B) as shown by the numeral 104 in FIG. 1B, which is the same flatness level as monocrystalline silicon wafer. This phenomenon is considered to be reconstruction of the surface rather than etching. (Emphasis added; col. 8, lines 8-17)

The second through fourth embodiments described in the Sato patent relate to forming SOI structures from a pair of wafers bonded together. On a first wafer, a monocrystalline silicon layer is grown over silicon that has been intentionally made porous, for example by anodization with HF. After bonding with a second wafer which includes an insulating layer, the

monocrystalline silicon is exposed by etching the porous silicon, thereby forming the silicon component of the SOI structure¹.

The resulting exposed monocrystalline silicon may then be smoothed by subsequent thermal treatment in the presence of hydrogen, as discussed in connection with the first embodiment. There is no discussion in the Sato patent that this smoothing process take place in conjunction with etching and deposition.

The conspicuous absence of any such teaching by the Sato patent has been raised by Applicants in response to previous office actions. The Examiner has in turn cited a series of decisions purporting to indicate the obviousness of the pending claims.

The performance of two steps simultaneously (i.e. applying a deposition species and an etching species) which have previously been performed in sequence (separately applying deposition species and etching species) was held to have been obvious. In re Tantincloux, 108 USPQ 126 (CCPA 1955). As a matter of fact section of any order of performing process steps is prima facie obvious in the absence of new or unexpected results. In re Burhans, 154 F.2d 690, 69 USPQ 330 (CCPA 1946); In re Gibson, 39 F.2d 975, 5 USPQ 230 (CCPA 1930)

As a threshold matter, Applicants reject the Examiner's characterization of the difference between the claimed methods and the Sato patent as a mere change "in the order of performing process steps".

In the instant case, the thermal, etching, and deposition conditions of the claimed methods are applied at the same time for the same purpose (to reduce surface roughness). By contrast, the etching and deposition steps of the Sato patent are performed at different stages in the process, for different purposes. For example, the deposition in the Sato patent describes initial formation of the monocrystalline silicon layer by epitaxial growth. This step occurs very early in the process of the Sato patent, prior even to the step of wafer bonding.

Regarding the purported etching in the Sato patent, this step is performed after wafer bonding in order to remove the porous silicon and expose the monocrystalline silicon. This etching is selective to the porous silicon over the monocrystalline silicon, and there is no

¹ By comparison, the silicon portion of the SOI structure of embodiments of the present invention, is formed by cleaving the wafer pair at a location different from the point of original bonding.

discussion in the Sato patent regarding roughness on the surface of the monocrystalline silicon layer after this step.

Thus the Sato patent describes a smoothing process after the monocrystalline layer has been exposed by etching, and long after original growth of the monocrystalline layer. This smoothing step involves thermal treatment in the presence of hydrogen, but does not involve deposition or etching. The teachings of the Sato patent cannot be relied upon to provide support for a conclusion of the obviousness of the pending claims.

The specific cases cited by the Examiner do not alter this conclusion. For example, In re Tantincloux related to preparation of high-temperature refractory bricks from clay. The prior art disclosed first flocculating a clay mixture, and then introducing bubbles, whereas the process sought to be patented required simultaneous performance of flocculating and bubbling. Unlike the instant case, the steps at issue were performed for the same purpose as in the prior art process, and were performed right after another in that prior art process.

In re Burhans described a process for introducing carbon dioxide to grain. The applicant relied on the specific order of steps to prove patentability, but each of these steps, and the purpose of those steps, was described in the prior art. Similarly, In re Gibson described a process for filling brake shoes. Again, the applicant relied on the specific order of steps to prove patentability, but the identity and purpose of each of those steps was described in the prior art. In contrast to both of these cases, here no teaching has been cited by the Examiner to support simultaneous etching and deposition to smoothen a surface.

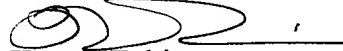
The cases cited by the Examiner, relating to relatively low-technology processes, do not support the obviousness of the pending claims. Steps performed at dramatically different stages of a complex process flow, for purposes entirely different than recited in the pending claims, cannot simply be lumped together to provide grounds for obviousness. The current obviousness rejections are improper and should be withdrawn.

Finally, the Examiner has combined the Sato patent with the Wolf Treatise in order to reject certain of the dependent claims. Based upon the failure of the Sato patent to suggest each of the limitations of the independent claims, it is respectfully asserted that these dependent claim rejections are improper and have been overcome as well.

Response to Office Action Mailed September 22, 2004

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested. If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



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